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Naphthalene Ingestion Induced Acute Hemolytic Crisis in Young Adult with Undiagnosed G6PD Deficiency

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Abstract

Naphthalene ball ingestion is a common toxicological emergency with most cases seen in children. It is mostly a non-life-threatening condition, but some cases can be complicated by methemoglobinemia and hemolysis. The incidence of hemolysis is greater in predisposing conditions like G6PD. We are hereby presenting a case of a young male who presented after naphthalene ball ingestion with methemoglobinemia and later developed acute hemolytic crisis during course of treatment and was later found out to be an undiagnosed case of G6PD.

Abbreviations: PBF: Peripheral Blood Film, Hb: Haemoglobin, MetHb: Methaemoglobin, G6PD: Glucose-6-Phosphate Dehydrogenase, ABG: Arterial Blood Gas, NAC: N-Acetylcysteine

Introduction

Naphthalene, an aromatic hydrocarbon, finds common application in household products like mothballs and deodorizers. The ingestion of naphthalene poses a frequent medical emergency, particularly among young children **[1,2]**. Although the majority of cases do not lead to complications, there has been a link to methemoglobinemia, and in a limited number of instances, even haemolysis. The likelihood of haemolysis is significantly heightened in patients with an elevated inherent vulnerability, such as those with G6PD deficiency **[2]**. We describe the case of an 18-year-old male who had no previous record of G6PD deficiency. He developed methemoglobinemia and haemolysis after consuming a mothball containing naphthalene. The condition worsened following the administration of methylene blue for methemoglobinemia caused by the naphthalene ingestion. Subsequent testing confirmed that he had G6PD deficiency.

Case Report

An 18-year-old male presented with a suspected case of having ingested four naphthalene balls around one day prior to his admission. Following the ingestion, the patient had six episodes of loose stools, which resolved on their own. He also complained of abdominal pain and a burning sensation in the upper abdominal region, along with noticing dark-coloured urine. At the time of presentation, the patient's blood pressure was 130/80 mmHg, heart rate was 88 beats per minute, oxygen saturation was 71% on room air, respiratory rate was 16 breaths per minute, and his random blood glucose level was 87 mg/dL. A physical examination revealed icteric

(jaundiced) skin, clear lung sounds bilaterally, no enlargement of the liver or spleen, and the patient was conscious and oriented to time, place, and person.

Initial arterial blood gas and chest X-ray did not show any significant abnormalities compared to the pulse oximeter reading. However, given the elevated levels of methaemoglobin (14%), the patient was given methylene blue after consulting with the national poison control centre. A subsequent complete blood count revealed a decrease in haemoglobin levels, with a peripheral blood film (PBF) indicating the presence of schistocytes. Additionally, there was an increase in unconjugated bilirubin levels and an elevated reticulocyte count. The worsening of haemolysis after methylene blue administration led to suspicion of underlying G6PD deficiency. G6PD levels were tested and found to be low, confirming the presence of G6PD deficiency.

The patient's treatment was tailored for an acute haemolytic crisis due to G6PD deficiency triggered by ingestion of naphthalene balls and exacerbated by methylene blue administration. To maintain a target haemoglobin level above 8 g/dL, the patient received transfusions of packed red blood cells. In addition, intravenous fluid therapy of 3-4 litres per day and oral folic acid tablets were administered. Plasma and urine haemoglobin levels were closely monitored and found to be significantly elevated above normal ranges. Eventually, the patient's urine colour returned to normal on the fifth day post-ingestion, and methaemoglobin levels dropped from 14% to 3%, accompanied by a subsequent increase in haemoglobin levels. The patient was discharged in a stable condition, without any symptoms.

During a follow-up visit in the outpatient department after six weeks, the patient's condition had improved, as indicated by an increase in haemoglobin levels. A repeated G6PD test once again demonstrated deficient levels. The patient received counselling about the disease and the various risk factors that can trigger a haemolytic crisis.

Fig 1. Cola coloured urine seen in acute haemolysis

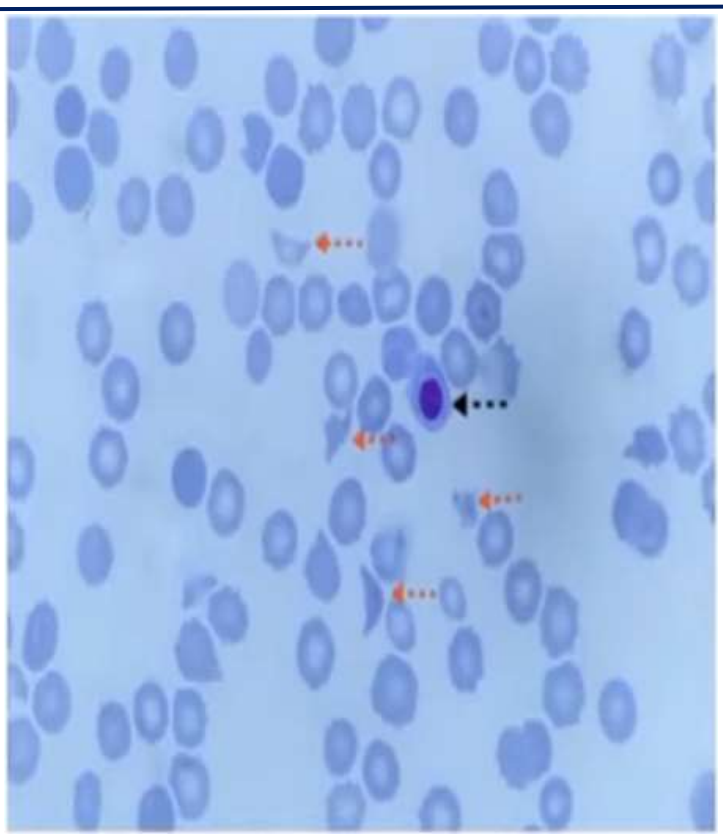

Fig 2. PBF showing irregularly shaped, jagged, fragmented schistocyte (Red arrow), lymphocyte(Black arrow)

Discussion

Naphthalene, an aromatic hydrocarbon compound frequently present in products like mothballs and insecticides, has been linked to diverse effects stemming from its capacity to produce free radicals upon ingestion **[3]**. An observed outcome is the transformation of Fe2 to Fe3 within haemoglobin (Hb), resulting in the creation of methaemoglobin (MetHb). The oxidative stress provoked by naphthalene ingestion can induce damage to cell membranes, culminating in a haemolytic crisis, particularly in individuals with underlying factors like glucose-6-phosphate dehydrogenase (G6PD) deficiency **[4,5]**. In our particular instance, the patient exhibited diminished oxygen saturation (spO2) levels as measured by pulse oximetry, despite receiving high-flow oxygen. This was observed without any clear connection to their clinical state, results from arterial blood gas (ABG) analysis, or interpretations from chest Xray assessments. This circumstance prompted concerns about the potential presence of methemoglobinemia in the patient **[6]**. Subsequent examinations of methaemoglobin levels validated their elevation so consulting the national poison control centre was deemed necessary. This consultation resulted in the decision to administer methylene blue as the treatment for methemoglobinemia **[6]**. However, following methylene blue administration, the patient experienced an acute haemolytic crisis **[7]**. Following this, the G6PD levels were done and were found to be diminished, confirming the presence of G6PD deficiency. The patient's management adhered to the protocols outlined for addressing acute haemolytic crises in individuals with G6PD deficiency. This encompassed measures such as hydration and blood transfusions, which ultimately led to the patient's complete recovery from a clinical standpoint **[8]**. In cases of methemoglobinemia, methylene blue is commonly used as a treatment; however, in patients with G6PD deficiency, this approach can induce a haemolytic crisis **[9]**. Therefore, in our patient, had we suspected G6PD deficiency earlier, we could have avoided administering methylene blue, which worsened the haemolytic crisis. Instead, we could have considered using N- acetylcysteine (NAC) for methemoglobinemia **[10]**, as it would have potentially prevented the aggravation of the haemolytic crisis. In conclusion, it is crucial to rule out G6PD deficiency in patients presenting with haemolysis following

naphthalene ball ingestion to avoid exacerbating haemolysis by administering methylene blue. This was illustrated in our case, emphasizing the importance of early identification of G6PD deficiency to guide appropriate management strategies.

Conclusion

In cases involving the ingestion of naphthalene balls, vigilance is warranted for the development of methemoglobinemia and haemolysis. Methemoglobinemia should be suspected if a patient's pulse oximetry reveals a low SpO2 that contradicts their clinical status, chest X-ray findings, and arterial blood gas analysis. Methylene blue administration is the appropriate treatment for methemoglobinemia. However, when concurrent signs of haemolysis are evident, such as dark cola-coloured urine, pallor, a decline in haemoglobin accompanied by an elevated reticulocyte count, increased unconjugated bilirubin, and elevated LDH, the possibility of G6PD deficiency should be considered.

A comprehensive patient history should be taken to rule out G6PD deficiency, and G6PD levels should be assessed both during presentation and again after the resolution of the haemolytic crisis. It's important to note that G6PD testing during an acute haemolytic crisis might yield false negative results. If a patient has a known history of G6PD deficiency or if G6PD deficiency is confirmed through testing at admission, methylene blue administration should be avoided. Instead, N-acetylcysteine (NAC) can be considered as an alternative approach.

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